

We claim:

1. A method of forming a SiGe layer having a relatively high Ge content, comprising:
  - preparing a silicon substrate;
  - depositing a layer of SiGe to a thickness of between about 100 nm to 500 nm,5 wherein the Ge content of the SiGe layer is equal to or greater than 10%;
  - implanting H<sub>2</sub><sup>+</sup> ions through the SiGe layer into the substrate at a dose of between about 2x10<sup>14</sup> cm<sup>-2</sup> to 2x10<sup>16</sup> cm<sup>-2</sup>, at an energy of between about 20 keV to 100+ keV;
  - low temperature thermal annealing at a temperature of between about 200°C to 400°C for between about ten minutes and ten hours;10 high temperature thermal annealing the substrate and SiGe layer, to relax the SiGe layer, in an inert atmosphere at a temperature of between about 650°C to 1000°C for between about 30 seconds and 30 minutes; and
  - depositing a layer of tensile-strained silicon on the relaxed SiGe layer to a thickness of between about 5 nm to 30 nm.15 2. The method of claim 1 wherein said depositing a layer of SiGe includes depositing the layer of SiGe at a temperature of between about 400°C to 600°C.  
  
3. The method of claim 1 which further includes, prior to said implanting, depositing a 20 layer of silicon oxide on the SiGe layer to a thickness of between about 50Å to 300Å.

4. The method of claim 1 which further includes, after said high temperature thermal annealing, depositing a layer of relaxed SiGe having a thickness of at least 100nm on the relaxed SiGe layer.
5. The method of claim 1 wherein said low temperature thermal annealing is done in an inert atmosphere taken from the group of inert atmospheres consisting of argon and nitrogen.

6. A method of forming a SiGe layer having a relatively high Ge content, comprising:  
preparing a silicon substrate, wherein the silicon substrate is taken from the group  
of substrates consisting of bulk silicon and SIMOX;  
depositing a layer of SiGe to a thickness of between about 100 nm to 500 nm,  
5 wherein the Ge content of the SiGe layer is equal to or greater than 10%, by number of atoms, and  
where said depositing is done at a temperature in a range of between about 400°C and 600°C;  
implanting H<sub>2</sub><sup>+</sup> ions through the SiGe layer into the substrate at a dose of between  
about 2x10<sup>14</sup> cm<sup>-2</sup> to 2x10<sup>16</sup> cm<sup>-2</sup>, at an energy of between about 20 keV to 100+ keV;  
low temperature thermal annealing at a temperature of between about 200°C to  
10 400°C for between about ten minutes and ten hours in an inert atmosphere taken from the group of  
inert atmospheres consisting of argon and nitrogen;  
thermal annealing the substrate and SiGe layer, to relax the SiGe layer, in an inert  
atmosphere at a temperature of between about 650°C to 1000°C for between about 30 seconds and  
30 minutes; and  
15 depositing a layer of material taken from the group of materials consisting of  
tensile-strained silicon, tensile strained SiGe, compressed SiGe, and a composite stack thereof, on  
the relaxed SiGe layer to a thickness of between about 5 nm to 30 nm.

7. The method of claim 6 which further includes, prior to said implanting, depositing a  
20 layer of silicon oxide on the SiGe layer to a thickness of between about 50Å to 300Å.

8. The method of claim 6 which further includes, after said high temperature thermal annealing, depositing a layer of relaxed SiGe having a thickness of about 100nm on the relaxed SiGe layer.

9. A method of forming a SiGe layer having a relatively high Ge content, comprising:  
preparing a silicon substrate;  
depositing a layer of SiGe to a thickness of between about 100 nm to 500 nm,

wherein the Ge content of the SiGe layer is equal to or greater than 10%, by number of atoms, and

5 at a temperature in a range of between about 400°C to 600°C;

implanting H<sub>2</sub><sup>+</sup> ions through the SiGe layer into the substrate at a dose of between  
about 2x10<sup>14</sup> cm<sup>-2</sup> to 2x10<sup>16</sup> cm<sup>-2</sup>, at an energy of between about 20 keV to 100+ keV;

low temperature thermal annealing at a temperature of between about 200°C to  
400°C for between about ten minutes and ten hours;

10 thermal annealing the substrate and SiGe layer, to highly relax the SiGe layer in an  
inert atmosphere at a temperature of between about 650°C to 1000°C for between about 30  
seconds and 30 minutes; and

depositing a layer of silicon-based material on the relaxed SiGe layer to a thickness  
of between about 5 nm to 30 nm.

15 10. The method of claim 9 which further includes, prior to said implanting, depositing a  
layer of silicon oxide on the SiGe layer to a thickness of between about 50Å to 300Å.

11. The method of claim 9 wherein said high temperature thermal annealing is done in  
20 an inert atmosphere taken from the group of inert atmospheres consisting of argon and nitrogen.

12. The method of claim 9 which further includes, after said thermal annealing,  
depositing a layer of relaxed SiGe having a thickness of at least 100nm on the relaxed SiGe layer.
13. The method of claim 9 wherein said depositing a layer of silicon-based material on  
the relaxed SiGe layer includes depositing a layer of material taken from the group of materials  
consisting of tensile-strained silicon, tensile strained SiGe, compressed SiGe, and a composite  
stack thereof.  
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